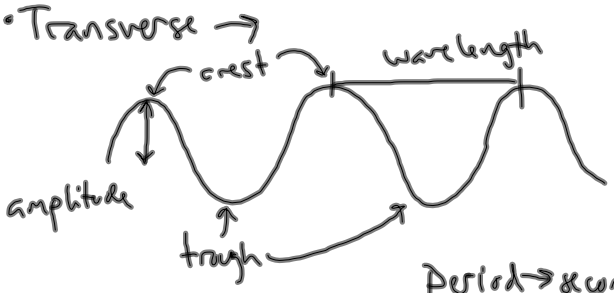
Waves, Sound, Light Review:

- Longitudinal Wave →

- Transverse →



Period → seconds

time for 1 wavelength

$$T = \frac{1}{f}$$

frequency → Hz

waves per second

λ → wavelength

$$v = \lambda f = \frac{\lambda}{T}$$

v ↑ wave speed

- Interference:
  - Constructive 
  - Destructive 
  - Reflection at a boundary:
    - Free → stays same
    - Fixed → flips
  - Drawings

- Standing Waves:
  - Nodes → destructive interference
  - Antinodes → constructive int.
  - Drawings and eqns.

$$f_n = \frac{nv}{2L} \quad n = 1, 2, 3, \ldots$$

- Intensity:

$$I = \frac{P}{4\pi r^2}$$

  - Decibel scale is typical scale

- Pitch → relative frequency according to something hearing

- Doppler effect → moving objects

λ longer, so f lower

λ shorter, so f higher

- Sound moves fastest through solids.

- Standing Waves in Pipes:
  - Open/open → antinodes at both ends

$$f_n = \frac{nv}{2L} \quad n = 1, 2, 3, \ldots$$

  - Open/closed → node at closed end, antinode at open end

$$f_n = \frac{nv}{4L} \quad n = 1, 3, 5, \ldots$$

- Light:
  - Wave/particle duality → we can think of light as either
  - doesn't need a medium
  - energy and frequency → $E = hf$
  - in a vacuum → $c = 3E8$ m/s
  - in other medium → $n = \frac{c}{v}$
    - ↳ index of refraction
  - produced in all directions
  - absorption, transmission, or reflection
  - technical name is electromagnetic radiation
  - all forms of radiation in chart called electromagnetic spectrum
  - types of reflection:
    - diffuse → light not coherent when reflection
    - spectral → light is coherent when reflecting

Types of Mirrors:

- Flat → virtual, upright, same size

- Concave spherical →

object is:	image is:
1) at infinity	point at focal point
2) outside C	inverted, real, smaller (bet. C and F)
3) at C	inverted, real, same size (at C)
4) bet. C and F	inverted, real, larger (outside C)
5) at F	no image formed
6) inside F	upright, virtual, larger (on right side of drawing)

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$M = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$$

- Convex mirror → image is smaller, upright, virtual

- Transmission:
  - Snell's law → $n_1 \sin\theta_1 = n_2 \sin\theta_2$ (measured from normal)
  - Refraction

object height is 20 cm

image height is 60 cm

concave mirror

object distance is 10 cm

find M, d_i, f,

image characteristics

$$M = \frac{h_i}{h_o} = \frac{60\text{ cm}}{20\text{ cm}} = 3$$

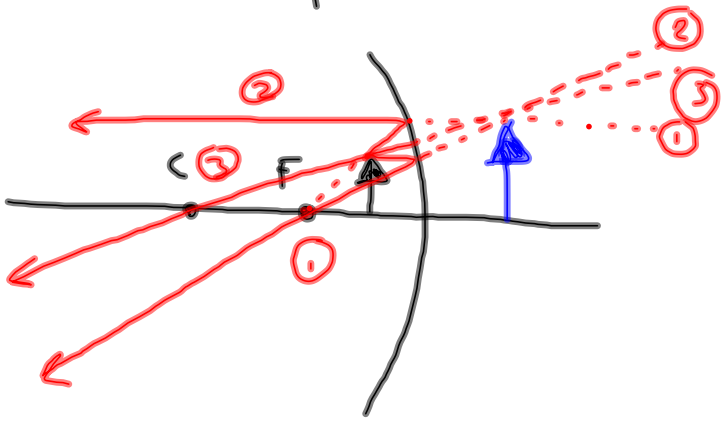
$$M = -\frac{d_i}{d_o}$$

$$d_i = -M d_o = -30\text{ cm}$$

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$f = 15\text{ cm}$$

image is: upright, virtual, larger



Convex mirror

object distance = 10 cm

object height = 4 cm

focal length = 5 cm

find h_i, d_i, M, image characteristics

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$d_i = -3.3 \text{ cm}$$

$$M = -\frac{d_i}{d_o} = .33$$

$$M = \frac{h_i}{h_o}$$

$$h_i = 1.33 \text{ cm}$$

image characteristics → upright, smaller, virtual